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LITTLE LEAF—AN ABERRANT FORM IN POTATO[1]

D. B. Robinson and R. H. Bagnall

An abnormal potato type, chiefly affecting the variety Sebago, has been observed in Prince Edward Island potato fields during the past three years. The incidence of this abnormality has not usually exceeded 1% in individual fields.

The descriptive name 'little leaf' is used by growers and inspectors. It refers to the most noticeable field characteristic, the smaller size of the leaves of affected plants (Fig. 1). Such plants seem normal in general appearance at the beginning of growth, but later exhibit dwarfing and usually develop an increased number of stems and stolons. In contrast to two or three stems on normal plants, 'little leaf' plants may develop several times that number. All parts of the affected plants are small; the size of individual leaves may be half that of a normal plant, roots of individual stems are less extensive and tubers are smaller in size and weight, though greater in number. The foliage of 'little leaf' plants is somewhat lustreless, a feature that helps detection in the field.

Materials and Methods

Over a three-year period, no further degradation of "little leaf' stocks was observed, but the tubers produced by affected plants were always found to give rise to 'little leaf' progeny. This suggested that a virus infection might be responsible, but our tests showed this to be unlikely. We tested for potato viruses A, F, M, S, X, and Y, (2) and the leaf roll virus (3). Virus X, which is widespread in 'healthy' Sebago, proved to be the only one of these viruses consistently present in 'little leaf' Sebago, and no apparent difference was found in the strains of virus X isolated from affected and non-affected plants. To see if some "unknown" virus might be the cause we tried to transmit the disease by grafting affected Sebago scions to normal plants of the varieties Saco, Sebago, and Katahdin. No symptoms developed on any of the test plants and their tubers invariably gave rise to normal plants when grown in tuber units for two successive seasons following the grafts. With virus discounted, a somatic mutation seems to be the most probable cause.

Results and Discussion

Comparisons of tuber production were made between normal and 'little leaf' plants grown in paired units in adjacent rows. Results of one test are given in Table 1. Regardless of the source or size of the seed tubers or cut seed-pieces, the tubers produced by 'little leaf' plants were smaller than normal, but more numerous.

Further tests showed that 'little leaf' can probably be eliminated from

[1]Accepted for publication February 17, 1961. Joint contribution, Experimental Farm, Canada Department of Agriculture, Charlottetown, Prince Edward Island (No. 101) and Research Station, Canada Department of Agriculture, Fredericton, New Brunswick (No. 55). Tuber samples supplied by G. C. Ramsay and A. W. Raynor, Plant Protection Division, Canada Department of Agriculture, Charlottetown, Prince Edward Island.

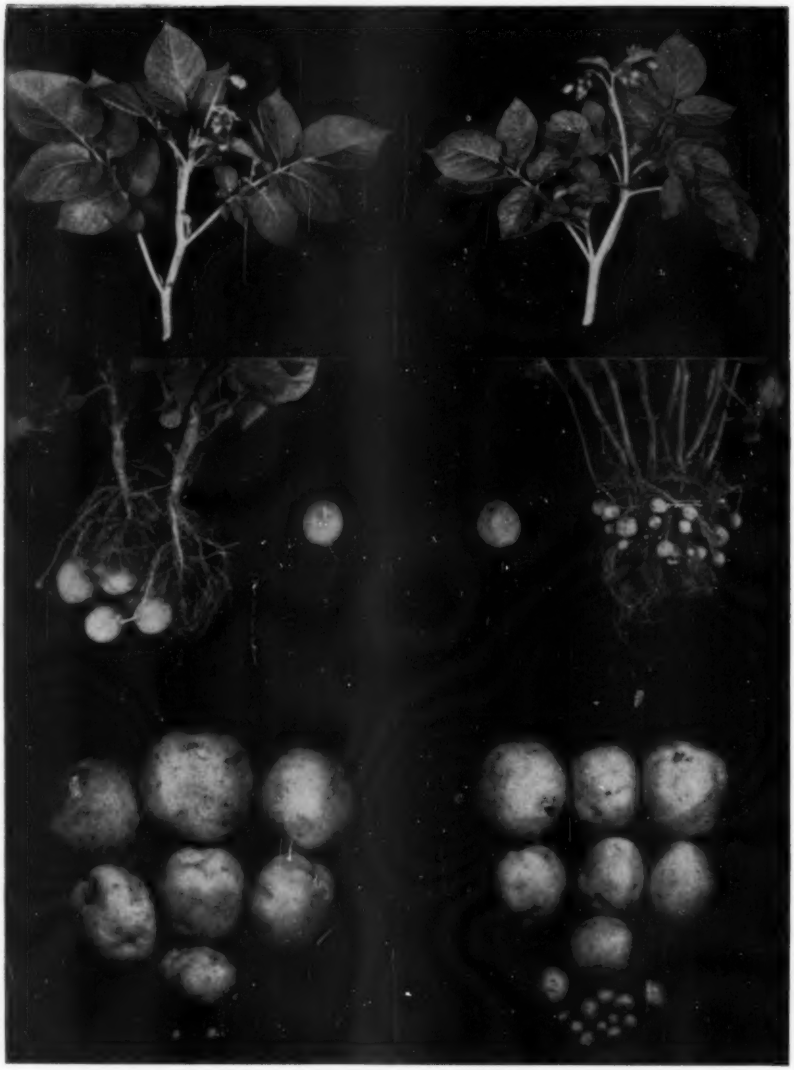

FIG 1.—Healthy Sebago (left) compared with 'little leaf' Sebago (right).
Top: Upper leaves and buds, 60 days after planting.
Middle: Stems and immature tubers. Whole seed tuber of the respective plants is also illustrated.
Bottom: Tubers at harvest.

TABLE 1.—*The effect of 'little leaf' on number and size of tubers.*

Seed source	No. of tubers[1]	Per cent of tubers in weight classes (ounces)		
		Up to 1.5	1.5 to 6	Over 6
Little leaf	235	44	55	1
Normal	107	28	56	16

[1]Yields from 20 plants of each source.

partially affected stocks by using large tubers as the seed source. One such potato stock, obtained from a field in which 8% of the plants were affected, was graded into several seed sizes by weight and planted as tuber units the following year. The results were as follows:

Seed tuber weight (oz.)	Per cent of plants showing 'little leaf'
Up to 1.5	15
1.5 to 6	14
Over 6	0

'Little leaf' seems to be similar to the British 'semi-wildings' (1) in that the plants are dwarfed and tubers small and numerous, though total yield may not be greatly reduced. But it appears to be distinct from 'wildings' (1,4). In 'wildings' there are also numerous stems and the tubers are small, but yield is considerably less than normal. 'Wildings' is also distinguished by absence of flowers, rounder contour of the terminal leaflets, and hypertrophy of the internodal parenchyma.

The aberrant potato types 'little leaf', 'semi-wildings', and 'wildings' probably occur where ever potatoes are grown, but they are often difficult to detect in the field. Detection is made easier if planting is done in tuber-units, and they can be virtually eliminated if large tubers are used as the seed source.

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THE EFFECTS OF ANTIVIRAL CHEMICALS ON POTATO VIRUS X-I[1]

NAGAYOSHI OSHIMA AND CLARK H. LIVINGSTON[2]

Most of the old established potato varieties grown in the United States are found to be universally infected with one or more strains of potato virus X. It would, therefore, seem highly desirable to develop techniques which would enable a researcher to produce virus X-free lines from these infected stocks. Such virus-free lines might be used in foundation seed programs as well as for fundamental research.

Norris (5) reported success in obtaining virus-free stocks of Green Mountain potato by subjecting the shoot tips to Malachite green treatment. The same chemical had previously been shown by Takahashi (9, 10) to inhibit tobacco mosaic virus multiplication in leaf discs which were floated on the solution. Thompson (11) studied the effects of Malachite green on potato viruses X and Y using the shoot tip of Dakota Red and Auklander Short Top potatoes grown as cultured tissues. He was unable to obtain virus-free tissues by this method. Manzer (4) investigated the antiviral properties of thiouracil as well as Malachite green, using tissue culture techniques. He encountered considerable difficulty in growing tissues in culture and was unable to obtain virus-free plants. He did, however, find that after soaking Irish Cobbler seed pieces in a thiouracil solution, plants proved to be free from virus X. It was suggested that the effectiveness of the thiouracil in this case was enhanced by the dormancy breaking process.

Studies have been initiated at this laboratory to improve potato tissue culture techniques. To date, particular attention has been given to developing the most favorable culture medium for growing tissues of the various potato varieties (6, 7 and 8). Tissues growing on this apparently favorable medium are then subjected to the action of antiviral chemicals incorporated into this medium. Therefore these studies were initiated in order to determine whether the growth rate of the potato tissue would exceed the rate of virus multiplication and other activities of the virus or viruses present, thereby escaping the infection to provide virus-free shoot tips bearing the genetic constitution of the parent material. Such virus-free tips are then excised, subcultured and subsequently will give rise to lines of virus-free tuber producing plants.

MATERIALS AND METHODS

A. *Culture of tissues on media supplemented with antiviral substances*—White's solid medium, enriched with gibberillin[3] (50 ppm), was used as the basic culture medium for growing potato tissues in these studies, (2, 3, 6, 7, 8, 12 and 13). Four components of White's medium, glycine, thiamine, pyrodoxine and nicotinic acid were replaced by potato

[1]Accepted for publication February 21, 1961. Published with the approval of the Director, Colorado Agricultural Experiment Station as Scientific Journal Series No. 701.

[2]Post-doctoral Research Fellow and Assistant Plant Pathologist, Department of Botany and Plant Pathology, Colorado State University, Fort Collins, Colo.

[3]Gibberellin was supplied by the courtesy of Chas. Pfizer and Company.

extract (500 ml per 1 liter of the medium). Potato extract was prepared by extracting 200 g of diced potato with 500 ml of boiling water and then filtering through cheesecloth. Substances reported to have antiviral properties (1, 5) namely: Malachite green at the rate of 2, 4, 6, 10 and 15 ppm or thiouracil at the rate of 5 and 10 ppm were added to the basic culture medium. Fifteen ml of the supplemented medium were placed into test tubes and autoclaved. The cultures were usually replicated 6 times throughout this investigation.

During the initial studies in the laboratory, shoot tips from both tuber sprouts and young potato plants which were infected with virus X were grown on the media containing these antiviral substances. The growth of these shoot tips, however, proved to be extremely slow in culture and were ultimately replaced by nodal stem segments for this investigation.

Nodal stem segments (about 8mm in length and 5mm in diameter) were cut from the plants of Russet Burbank which had been grown in the greenhouse for a period of approximately a month after emergence as potted plants. After washing with water, the stem segments were surface sterilized for 6 minutes with a 20% Clorox solution to which a wetting agent, Triton-1956 had been added (at the rate of 1 drop per 500 ml of Clorox solution). Each segment was then transferred to a test tube containing the solidified nutrient medium and incubated under conditions of continuous light at room temperature.

When new shoots developed in culture, each was assayed for virus X activity by rubbing the juice extract of the young shoot onto the leaves of *Gomphrena globosa* L. Approximately 5mm of the terminal portion of the young shoot was excised and macerated in 0.1 ml of 0.5 M NaH_2PO_4 buffer solution and applied to the leaves of *G. globosa* which had been previously dusted with No. 400 mesh carborundum. After 1 week of incubation, the number of local lesions was recorded.

B. *Culture of tissue soaked in antiviral solutions* — Nodal stem segments of virus X infected Red McClure potatoes were immersed in thiouracil solution (50 and 100 ppm) for periods of 1, 2 and 3 hours, surface sterilized, transferred to the modified White's medium and incubated for a period of 1 week in continuous light at room temperature. The amount of virus X activity in the new shoots was similarly assayed by inoculating *G. globosa* leaves with juice as above.

Results

Potato stem nodal segments grew well on the modified White's medium containing gibberellin and antiviral chemicals with no evidence of phytotoxicity at the concentrations tested. At the end of the 1 week incubation period, the new shoots were as long as 4 cm.

When the concentration of Malachite green in the medium was increased, as shown in Fig. 1, the detectable level of virus activity as indicated by the number of local lesions on the leaves of *G. globosa* generally decreased. The number of tips which gave negative reaction on the leaves of *G. globosa* was increased at the same time (Fig. 2). Further investigation is in progress in order to determine whether these tips are actually free from virus X.

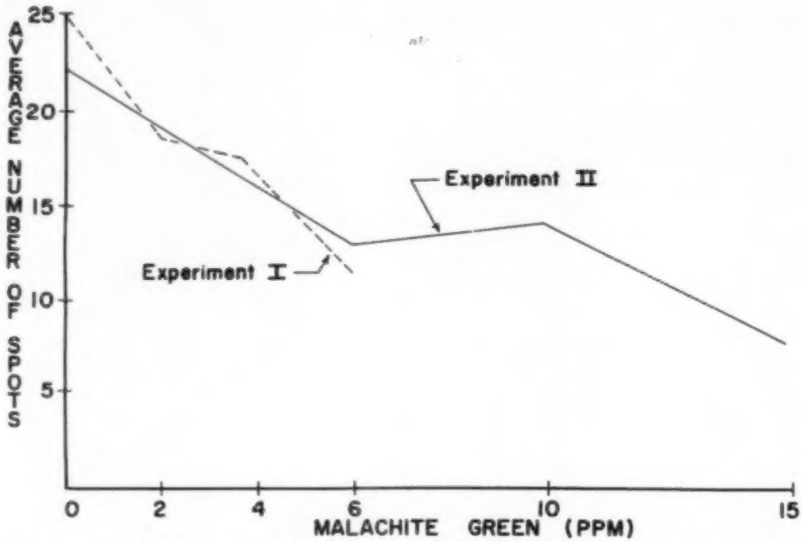

FIG. 1.—The effect of Malachite green on virus X activity in Russet Burbank potato shoots grown in culture. (Virus activity was determined by the number of local lesions on *Gomphrena globosa*. In Experiment 1 the data are the average of 2 trials with 5 replicates. In Experiment 2 the data are the average of 3 trials with 6 replicates.)

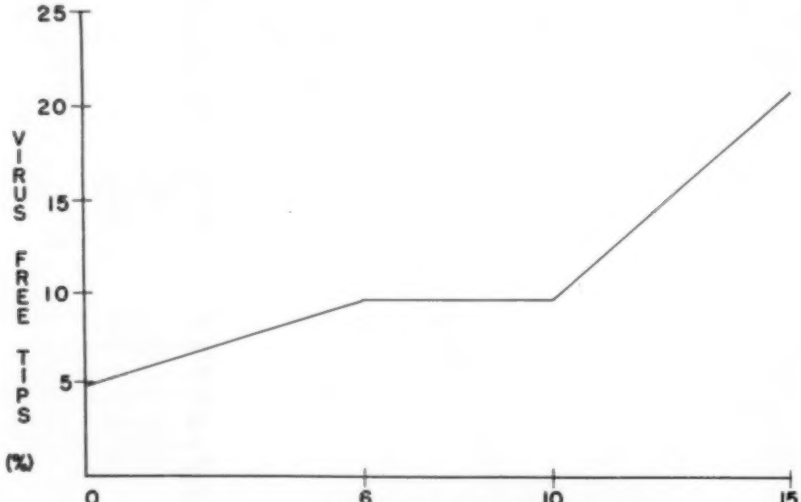

FIG. 2.—The effect of Malachite green on the number of apparent virus-free stem tips produced from stem nodal segments of Russet Burbank potatoes grown in culture. (The data are the average of 3 trials with 6 replicates.)

The effect of thiouracil on virus activity of cultured potato stem segments is given in Fig. 3. At a concentration of 5 ppm, thiouracil reduced detectible virus activities. This effect was, however, not evident at the higher concentration of 10 ppm.

The detectible virus activity in the new shoots of Red McClure potatoes was reduced following the soaking of parent stem segments in thiouracil solution at 50 ppm for the periods of 1, 2 and 3 hours (Fig. 4). Continued soaking at the concentration of 100 ppm appears to have reduced the apparent effectiveness of thiouracil as an antiviral agent.

This technique appears promising as a means of evaluating other substances suspected of possessing antiviral properties.

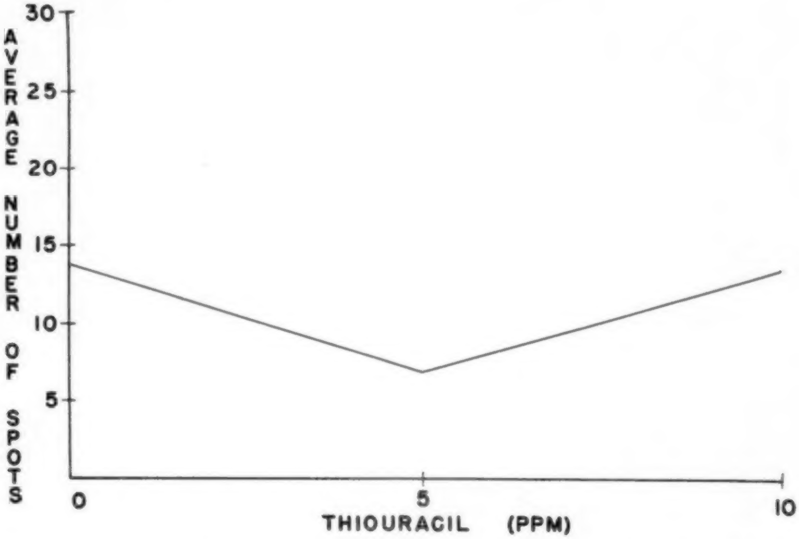

FIG. 3.—The effect of thiouracil on virus X activity in Russet Burbank potato shoots grown in culture. (Virus concentration was determined by the number of local lesions on *G. globosa*. The data are the average of 2 trials with 6 replicates.)

SUMMARY

The antiviral properties of Malachite green and thiouracil with regard to potato virus X were studied using tissue culture technique. Stem nodal tissues of Russet Burbank potatoes were grown in culture using modified White's medium enriched with gibberellin and containing Malachite green at the rate of 2, 4, 6, 10 and 15 ppm or thiouracil at the rate of 5 and 10 ppm. Stem tissues grew well with no evidence of phytotoxicity due to the presence of antiviral chemicals. Antiviral properties of these chemicals were evaluated by inoculating the leaves of *G. globosa* with the extract of the apical portion of the newly developed shoots. As the concentration of Malachite green was increased, the detectible amounts of virus activity was generally reduced, and the number of apparently

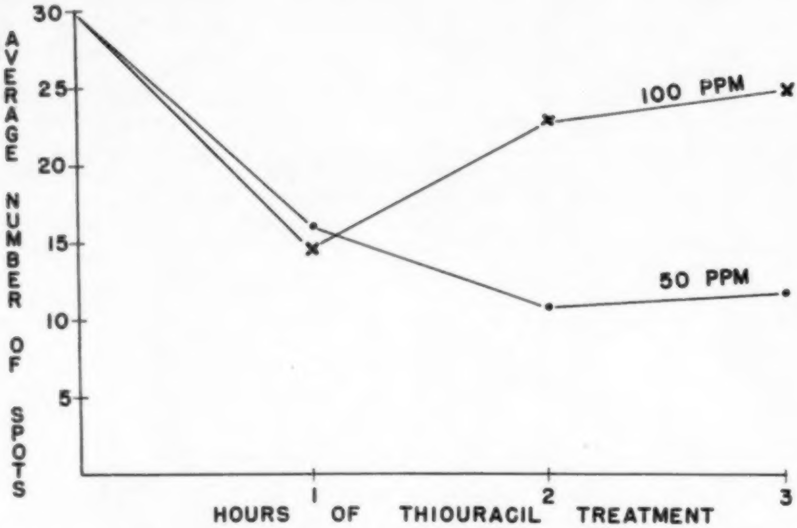

FIG. 4.—The effect of soaking stem nodal tissues of Red McClure potatoes in thiouracil solution on virus X activity. (Virus activity was determined by the number of local lesions on *G. globosa*. The data are averages of 7 replicates.)

virus-free tips was increased. Thiouracil treatment at 5 ppm reduced the detectible virus activity present in the new shoots, but there were no antiviral effects at a concentration of 10 ppm.

The effects of soaking stem nodal segments in thiouracil solution on virus X was studied using Red McClure potatoes. Stem segments were immersed in thiouracil solution at the rate of 50 and 100 ppm for periods of 1, 2 and 3 hours and then maintained on modified White's solid medium. The detectible virus activity of the new young shoot tissues was reduced following the soaking treatment of stem segments in solution at the rate of 50 ppm. Concentration of 100 ppm exhibited antiviral properties only with 1 hour treatment.

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CATOOSA — A NEW MEDIUM-EARLY RED POTATO IMMUNE FROM COMMON RACES OF THE LATE BLIGHT FUNGUS AND RESISTANT TO SCAB[1]

T. P. Dykstra[2], T. R. Gilmore[3] and Julian C. Miller[4]

On October 29, 1959 the Crops Research Division of the United States Department of Agriculture, in cooperation with the Tennessee and Louisiana Agricultural Experiment Stations, announced the release of the new potato variety Catoosa[5]. This red variety is the first release to growers that is highly resistant to scab and also immune from the common races of the late blight fungus.

Origin

The Catoosa variety originated by selfing seedling TL 1859.

Catoosa (TL 6279)	TL 1859	U.S.D.A. Seedling x 96-56	Earlaine x U.S.D.A. Seedling 3895-13
		x	
		Pontiac	Katahdin x Triumph

Selection TL 1859 is a heavy-yielding, late blight- and scab-resistant selection of excellent cooking quality. Its tubers are only light pink and therefore unacceptable to the trade. Several hundred selfed seedlings from TL 1859 were grown and tested to obtain an improved tuber skin color. Only one selection TL 6279, combined a desirable skin color with late blight and scab resistance.

Description

PLANTS: medium-early maturing, large erect. *Stems:* medium thick, angled. *Nodes:* slightly swollen, green. *Internodes:* green. *Wings:* medium in size, straight, single and green. *Stipules:* small, green, pubescent. *Leaves:* medium in size, medium open, green. *Midribs:* green scantily pubescent. *Terminal leaflets:* medium in size, ovate, acute and lobed. *Primary leaflets:* large, ovate, width/length ratio 3:4. *Secondary*

[1]Accepted for publication March 1, 1961.
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[3]Associate Horticulturist, University of Tennessee, Crossville, Tennessee.
[4]Head Horticulturist, University of Louisiana, Baton Rouge, Louisiana.
[5]Catoosa was selected and developed in our plots at the Branch Experiment Station of the University of Tennessee at Crossville on the Cumberland Plateau. This large area was at one time Cherokee Indian territory and was called in Cherokee language "Catoosa" meaning "High Place".

leaflets: many. *Position:* between pairs of primary leaflets. *Tertiary leaflets:* none. *Inflorescence:* medium-branched. *Leafy bracts:* few. *Peduncles:* in axils of petioles and mainstem. *Length:* medium long, green. *Pubescence:* scanty. *Cork ring:* conspicuous, with reddish pigment.

FLOWERS: *Buds:* green. *Calyx lobes:* slightly pigmented, owl-shaped, short (4-6 mm.). *Tips:* straight and scantily pubescent. *Corolla:* medium in size (25-31 mm), violet with white tips. *Anthers:* lemon yellow. *Pollen:* scant and of poor quality. *Styles:* straight. *Stigmas:* globose, not lobed, and green.

TUBERS: round to oblong, depending upon environment. Mean length 100 mm., mean width 70 mm., mean thickness 65 mm., indices width to length 70, thickness to length 65, thickness to width 93. *Skin:* smooth, bright red color in periderm with some variation, lenticels enlarged in wet soils. *Eyes:* shallow, of same color as skin with heavy eyebrows. *Flesh:* white. *Sprouts:* reddish purple at the base and little in papilla when developed in the dark. *Maturity:* medium early in the South, late in northern states.

Disease Resistance

Catoosa is immune from the common races of the late blight fungus. Plants of Catoosa and of other potato varieties were placed in a moist chamber in the greenhouse and were inoculated with zoospores of the common races of late blight (*Phytophthora infestans*). This test was repeated several times. The vines of the susceptible varieties were always killed back, whereas those of Catoosa never became infected.

Exposure to natural infection by the late blight fungus in an unsprayed field in Alabama in 1959 killed vines of Pontiac, LaSoda, and other blight-susceptible varieties. The foliage of Catoosa grown in the same field remained free from infection.

Catoosa, although not immune from the scab organism (*Streptomyces scabies*), is highly resistant to infection. The pustules that may develop on tubers grown in soils heavily infested with the scab organism are usually superficial shallow lesions of type 1 or 2. Twenty-five per cent of the tubers of Pontiac and LaSoda grown in a field in Louisiana in 1960 were severely infected with scab, but in the same field the tubers of Catoosa remained completely free from infection. Similar observations on scab resistance were made in Alabama.

Other Characters

The Catoosa is medium-early in maturity when grown in the South. Yielding ability and other characteristics of Catoosa grown in Alabama, Florida, Louisiana, Maine, Mississippi, North Dakota, South Carolina, Tennessee, Texas and Wisconsin have been observed. Its yields compared favorably with those of Red LaSoda and Red Pontiac, the two most widely grown red varieties in the southern states. In most of the yield tests in these states Tennessee-grown seed of Catoosa was used frequently in comparison with northern seed of Red LaSoda and Red Pontiac. In

such a test in the Rio Grande Valley in Texas in 1958, Catoosa yielded 254 bushels of U. S No. 1 tubers as compared with yields of 275 and 305 bushels of Red Pontiac and Red LaSoda. In 1958, with Tennessee-grown seed planted in Tennessee, Catoosa outyielded all the seedlings and other varieties with a yield of 495 bushels per acre as compared with 401 bushels of Kennebec and 374 bushels of TL 1859. In a Louisiana test in 1959, Tennessee-grown seed of Catocsa and of Red LaSoda yielded 332 and 169 bushels per acre respectively, but each variety produced 375 bushels per acre from South Dakota-grown seed.

In 1960, seed of Red Pontiac, Red LaSoda, and Catoosa was obtained from the same farm in Wisconsin and used in yield tests in Louisiana and Alabama. These tests showed that northern seed of these three varieties produced no appreciable differences in yield (Table 1).

In the seed producing areas of the northern states Catoosa has also produced high yields, indicating that it can be grown profitably for seed. Its maturity is generally later when grown in the North.

TABLE 1.—*Total yield per acre of U. S. No. 1 tubers of Catoosa and other varieties of potato, 1960.*[1]

Place and Variety	Replication		Yield (bushels)	Solids (per cent)
	Number	Row length (feet)		
Fairhope, Alabama	3	25		
Catoosa			350	19.0
Red Pontiac			320	18.6
Red LaSoda			360	19.0
Diamond, Louisiana	3	25		
Catoosa			312	18.8
Red Pontiac			261	17.8
Red LaSoda			391	19.3
Baton, Rouge, Louisiana	3	25		
Catoosa			334	16.2
Red Pontiac			312	16.2
Red LaSoda			261	16.2
Baton Rouge, Louisiana Regional Trial	3	25		
Catoosa			195	15.8
Red Pontiac			195	15.0
Red LaSoda			277	16.2
New Roads, Louisiana	4	40		
Catoosa			240	16.0
Red Pontiac			225	17.5
Red LaSoda			240	16.0
Average				
Catoosa			286	17.2
Red Pontiac			263	17.0
Red LaSoda			306	17.4

[1]Seed tubers of all varieties obtained from the same source in Wisconsin.

The solids content of Catoosa has varied from 15 to 20% depending upon area where grown and climatic condition. Its cooking quality is very good and is superior to what its dry matter content would indicate. In tests conducted in Florida it was found to be excellent for the production of French fried potatoes. It is not recommended for chipping.

Summary

Catoosa has many of the characteristics of Pontiac and should be well adapted to production areas where Pontiac is grown. It is the first red variety released to growers that is immune from late blight and resistant to scab.

HEAT INACTIVATION OF LEAFROLL VIRUS IN POTATO TUBER TISSUES[1]

A. Hamid and S. B. Locke[2]

Introduction

In 1949 Kassanis reported (2) the first heat inactivation of leafroll virus in potato tubers. A previous attempt in this direction by Blodgett (1) did not inactivate the virus. Following the success of Kassanis, a number of workers confirmed his main result (Rozendaal in 1951, Roland in 1952, Thung in 1952 and Thirumalachar in 1954). Kassanis (3) found that tubers of two potato varieties held in a humid atmosphere at 37.5 C for approximately 24 days were freed from active leafroll virus. However, at the treatment level where 100% inactivation of the virus occurred, survival of the tubers had dropped to 64 and 40% respectively in the two varieties. Roland (4) failed to get complete inactivation following any of his heat treatments. The response of three potato varieties were varied, the highest inactivation level being 50% in the tubers of Alpha variety after five days' treatment at 44 C. Thung (7), using nine potato varieties and treatments at 40 C for 12 to 13 days, obtained inactivation (ranging from 25.0 to 100.0%) in nine out of 13 lots. The average inactivation for all lots was 61.4% of surviving tubers, whereas average survival was only 15.0%.

Thirumalachar (6) observed that leafroll-affected tubers stored in thatched houses in India survived without injury summer temperatures reaching 41.7 C in May and June and in all cases produced healthy plants the following season. Leafroll virus-infected tubers held in cold storage for the same period of time gave rise to plants 100% affected with leafroll. Subsequent experiments showed that six months of warm storage was required to eliminate all active virus.

From the foregoing reports it is evident that treatment at high constant temperatures results in low survival of the tubers, while the inactivation attained is variable. The report of Thirumalachar is of special interest because it indicates that high survival of tubers and complete inactivation of the virus was obtained under natural conditions. Since the mean temperatures recorded for the summer months were only 31 to 32 C, it appears that inactivation must have occurred during periods when the temperature went higher than these average figures, possibly during the peaks of a diurnal fluctuation.

The work reported here was undertaken to determine how the chief commercial variety of potato grown in Washington (Russet Burbank) would react to heat treatment and to learn if the leafroll virus could be eliminated from its tubers by high constant temperatures. Secondly, the intention was to explore in a preliminary way the effect of fluctuating temperature on tuber survival and virus inactivation.

[1]Accepted for publication February 1, 1961. Scientific paper No. 2075. Washington Agricultural Experiment Stations, Pullman, Washington. Work was conducted under Project 1465.

[2]Research Assistant in Plant Pathology and Plant Pathologist, respectively, Washington Agricultural Experiment Stations, Pullman, Wash.

Materials and Methods

Russet Burbank tubers used in these experiments were grown in the field at Pullman during the 1957 season and were found to be 86% infected in the field with leafroll virus. Tubers of the other varieties used were of the same origin but were indexed in the greenhouse and those infected with leafroll were selected for the experiment.

With the exception of one experiment where whole tubers were used, eye-pieces of uniform size (2 cm diam.) were cut with a "salad baller" and allowed to heal under warm, moist conditions before being subjected to heat treatment. It was assumed that more uniform results would be obtained with eye-pieces of the same size than with whole tubers of varying sizes.

Whole tubers were exposed to the treatment temperatures in a constant temperature incubator containing an open dish of water to maintain a high relative humidity. Eye-pieces were placed in shallow dishes of moist peat moss during treatment. Where fluctuating temperatures were used, only the eye-pieces were removed from the incubators, the dishes of peat moss remaining at the incubator temperature. This reduced the time required to bring the eye-pieces to treatment temperature when they were returned to the incubators.

Following treatment, the eye-pieces were planted in flats of clean, moist peat moss in the greenhouse. Later, those surviving the treatments were potted in soil and grown to the point where symptoms, if any developed, could be recorded.

Experimental Results

In the experiment with whole tubers of the Russet Burbank variety and constant temperature treatments it was found that survival at 34 C after six weeks was about 70% and after seven weeks it was zero per cent. At 37 C survival after three weeks was 43% and after four weeks it was zero. Inactivation of the virus in surviving tubers was complete after five and six weeks at 34 C and after three weeks at 37 C (Table 1). These results are in close agreement with those obtained by Kassanis for the two varieties which he used (Majestic and Arran Council).

The results of experiments with Russet Burbank eye-pieces and constant-temperature treatments are summarized in Tables 2 and 3. The survival of treated eye-pieces was very low at 34 C after three weeks' treatment and at 37 C after two weeks' treatment. No eye-pieces survived after one week at 40 C. No inactivation of the virus had occurred in any of the surviving eye-pieces.

One experiment was carried out using Russet Burbank eye-pieces treated daily with one, two, three and four hours at 40 C (Table 4) and for the remainder of the time at 16-20 C. Some of the treatments were carried out over a period of eight weeks and survival was 100% in all cases involving these long treatments. In several treatments of shorter duration survival was less than 100%, but death of the eye-pieces was not attributed directly to heat treatment in these cases. The virus was inactivated in a progressively greater proportion of the eye-pieces as the

TABLE 1.—*Reactions of whole tubers of Russet Burbank potato to constant temperature treatment at 34 and 37 C.*

Duration of treatment	Tubers treated	Tubers surviving and growing	Plants showing leafroll
(Weeks)	(No.)	(No.)	(No.)
		34 C	
4	7	4	2
5	7	4	0
6	7	5	0
7	7	0	..
		37 C	
3	7	3	0
4	7	0	..
5	7	0	..
6	7	0	..
		Untreated	
0	28	22	19

TABLE 2.—*Reaction of eye-pieces of Russet Burbank potato to constant temperature treatments at 34, 37 and 40 C.*

Duration of treatment	Eye-pieces treated	Eye-pieces surviving and growing	Plants showing leafroll
(Weeks)	(No.)	(No.)	(No.)
		34 C	
1	22	22	22
3	22	4	4
4	66	4	4
		37 C	
1	22	0	..
2	22	3	3
3	22	0	..
4	22	0	..
5	22	0	..
		40 C	
1	22	0	..
2	22	0	..
3	22	0	..
4	22	0	..
5	22	0	..
		Control (18-21 C)	
1	22	32	32
2	22	22	22
3	22	22	22
4	44	38	38

TABLE 3.—*Reactions of eye-pieces of Russet Burbank potato to constant temperature treatments at 34, 37 and 40 C.*

Duration of treatment (Weeks)	Eye-pieces treated (No.)	Eye-pieces surviving and growing (No.)	Plants showing leafroll (No.)
34 C			
3	14	2	2
4	21	2	2
37 C			
2	7	2	2
3	7	0	..
40 C			
1	7	0	..
Control (18-21 C)			
6	15	8	8

TABLE 4.—*Reactions of eye-pieces of Russet Burbank potato to fluctuating temperature treatments.*

Duration of treatment (Weeks)	Eye-pieces treated (No.)	Eye-pieces surviving and growing (No.)	Plants showing leafroll (No.)
40 C—1 hr.; 16-20 C—23 hrs. daily			
2	7	6	6
4	7	7	6
6	7	7	3
8	7	7	1
40 C—2 hrs.; 16-20 C—22 hrs. daily			
2	7	6	5
4	7	7	5
6	7	7	4
8	7	7	0
40 C—3 hrs.; 16-20 C—21 hrs. daily			
2	7	4	4
4	7	7	5
6	7	7	3
8	7	7	0
40 C—4 hrs.; 16-20 C—20 hrs. daily			
2	7	5	5
4	7	5	3
6	7	7	0
8	7	7	2
Untreated			
0	38	38	38

duration of the experiment lengthened. No inactivation resulted from two weeks' treatment of one hour daily at 40 C. After eight weeks of this treatment the virus had been inactivated in 85.7% of the eye-pieces. Inactivation of the virus in 100% of the eye-pieces occurred after eight weeks of treatment with two and three hours at 40 C daily and after six weeks of treatment with four hours daily at 40 C. However, inactivation was incomplete after eight weeks of the last treatment. No explanation of this inconsistency is at hand.

An experiment was carried out using eye-pieces of Katahdin potatoes in which the treatment temperature was alternated between 45 C and room temperature (25 to 30 C). The results of this experiment are summarized in Table 5. Survival of eye-pieces was much lower than that obtained in the preceding experiment, and this may have been because of the higher room temperature as well as the higher treatment temperatures. However, inactivation was complete in all treatments where eye-pieces survived, even in the case of minimum treatment with one hour daily at 45 C for two weeks.

A final experiment was carried out with eye-pieces of Mohawk potatoes and a treatment temperature of 50 C alternating with room temperature (25-30 C) (Table 6). Here again, survival of the treated eye-pieces was low. Inactivation was variable, ranging from 50 to 100% of the surviving eye-pieces, and in some cases was greater after two weeks' treatment than after four weeks' treatment.

TABLE 5.—*Reactions of eye-pieces of Katahdin potato to fluctuating temperature.*

Duration of treatment (Weeks)	Eye-pieces treated (No.)	Eye-pieces surviving and growing (No.)	Plants showing leafroll (No.)
	45 C—1 hr.; 25-30 C—23 hrs. daily		
2	7	5	0
4	7	1	0
6	14	10	0
	45 C—2 hrs.; 25-30 C—22 hrs. daily		
2	7	7	0
4	7	0	..
6	14	8	0
	45 C—3 hrs.; 25-30 C—21 hrs. daily		
2	7	5	0
4	7	1	0
6	7	0	..
8	7	0	..
	45 C—4 hrs.; 25-30 C—20 hrs. daily		
2	7	3	0
4	7	5	0
6	7	0	..
8	7	0	..

TABLE 6.—*Reactions of eye-pieces of Mohawk potato to fluctuating temperature treatment.*

Duration of treatment	Eye-pieces treated	Eye-pieces surviving and growing	Plants showing leafroll
(Weeks)	(No.)	(No.)	(No.)
	50 C—1 hr.; 25-30 C—23 hrs. daily		
2	7	5	1
4	21	10	5
	50 C—2 hrs.; 25-30 C—22 hrs. daily		
2	7	6	0
4	21	3	1
	50 C—3 hrs.; 25-30 C—21 hrs. daily		
2	7	4	1
4	7	0	..
	50 C—4 hrs.; 25-30 C—20 hrs. daily		
2	7	0	..
4	7	0	..
	Untreated		
0	8	3	3

Discussion and Conclusions

Judging from the experiment with whole tubers, it appears that the Russet Burbank variety is about as tolerant of heat treatment as are the varieties used by Kassanis. Differences in heat tolerance among varieties may exist, but the experiments here reported do not show them. Eye-pieces cut from the tubers proved to be more sensitive to heat injury than whole tubers, there being no survival after treatment at a constant temperature of 37 C for three weeks. Furthermore, there was no inactivation of the virus in surviving eye-pieces as a result of this treatment. From these results, it would appear that constant high temperature treatment holds little promise for a practical, therapeutical approach to the potato leafroll disease.

In contrast to the foregoing, good survival was obtained following repeated, brief exposure to high temperature (40 C) with relatively long alternating periods at room temperature (16-20 C). This fact and the accompanying high proportion of eye-pieces freed from active virus, suggests that these fluctuating temperature treatments may lead to a very important control procedure. The results obtained here help explain the findings of Thirumalachar, who worked with naturally fluctuating, diurnal temperatures. The results obtained with the Katahdin and Mohawk varieties are not directly comparable with those obtained with Russet Burbank since the temperature treatments were not the same. It remains for further investigation to determine the differences among potato varieties with respect to heat tolerance and heat inactivation of the leafroll virus in them.

Summary

Heat inactivation of leafroll virus in tuber tissues of three potato varieties (Russet Burbank, Katahdin, and Mohawk) was studied. Russet Burbank did not tolerate high constant temperatures and a low proportion of tubers and eye-pieces survived the treatments. On the other hand, Russet Burbank eye-pieces survived, with few exceptions, treatment at 40 C for four hours alternating with room temperaure (16-20 C) for 20 hours daily for as long as eight weeks. Inactivation of the virus was complete after six weeks of this treatment. Results obtained with the Katahdin and Mohawk varieties in similar tests were variable, and this possibly may be attributed to the higher room temperature (25-30 C) prevailing during these experiments.

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NEWS AND REVIEWS

HONORARY LIFE MEMBERS HONORED AT THE 45TH ANNUAL MEETING

JULIAN C. MILLER

Dr. Julian C. Miller was born at Lexington, South Carolina, on November 29, 1895. He took his B.S. degree at Clemson College in 1921, taking time out from his studies to serve as ensign in the Navy during World War I. He was instructor at North Carolina State College from 1921 to 1923, at which time he returned to his native state as county agent in Orangeburg County for the following three years. He then accepted a graduate assistantship under Dr. H. C. Thompson, Head of the Department of Vegetable Crops at Cornell University, where he received the M.S. and Ph.D. degrees. After receiving the Ph.D. degree at that institution in 1928, he was appointed horticulturist at the Oklahoma Agricultural College and remained there until July, 1929, at which time he accepted his present position as Head of the Department of Horticulture at Louisiana State University.

When Dr. Miller came to Louisiana State University in July, 1929,

there were only three other trained horticulturists in the state, one each in teaching, extension and at a substation. Today, there are 17 staff members at the main station, three at an outfield research center, six horticulturists in the Extension Service at the University and 7 county agents trained in horticulture. From one horticultural substation in existence in 1929, the number has grown to three with a staff of 12 well-trained individuals. During this period more than 200 students have been trained, most of whom have received the master or doctor's degree at Louisiana State University.

Despite the enviable record of training students, Dr. Miller did not overlook his research program. He has over 150 publications, including bulletins and scientific articles, to his credit. In addition to potatoes, Dr. Miller has also initiated breeding programs with strawberries, English peas, Lima beans, snap beans, okra, onions, shallots, pumpkin, carrots, squash, hot peppers, sweet corn and in the fruit program in North Louisiana with peaches.

Dr. Miller was the first to develop a potato breeding program in the South. One of his introductions, Red LaSoda, is bringing the Irish potato industry back, which was considered as practically a lost industry in Louisiana. This variety ranks 6th in the amount of seed certified in the United States and is one of the leading varieties in the seed-producing states as well as the lower South.

Dr. Miller has served as president of the Potato Association of America and the American Society for Horticultural Science. He is listed in Who's Who in America and in the American Men of Science. He was named Progressive Farmers Man of the Year for Louisiana in 1940, Man of the South in 1947, and Vegetable Man of the Year in 1957. He is National Regent for Phi Kappa Phi. In June 1961 an honorary Doctor of Science Degree was conferred on him by Clemson College.

I consider it an honor and a pleasure to present Julian Miller for Honorary Life Membership in the Potato Association of America.

—August Kehr

SAM KENNEDY

The story of Sam Kennedy starts in 1883 when Sam was born the fifth and youngest son of a creamery operator. The family lived in Shellrock, Iowa at the time, but the father's business took them to many areas before settling down in Clear Lake, Iowa early in 1901. Sam started work at 15 on the railroad, but changed jobs as often as the family changed towns. In 1901 Sam and an older brother Robert went to Kansas in a covered wagon where they plowed up fifteen acres of buffalo grass to plant beans and corn. By fall the corn still hadn't germinated so Sam and Robert went back to Iowa. The following spring Sam planted 10 acres of potatoes, and with one horse started his vegetable growing career. At first, most of the crop was sold locally, but by 1907 Sam had shipped his first car of Early Ohio's to Chicago.

A turning point occurred about 1912 for Sam Kennedy. At that time, onions were grown on mineral soil and purslane was the main weed problem. With a wheel hoe, one man could cultivate less than an acre per day, and this limited his operation to about ten acres. Cultivators at this time were unreliable, so Sam designed, built and patented a cultivator

which worked almost as well as the wheel hoe. This cultivator was pulled behind a Model T Ford with a shortened wheel base, and would do about 20 acres a day. At the end of the First World War, the Hollandale area in Southern Minnesota was opened and large yields of onions and potatoes were being realized. Sam, always ready to try anything which would increase production without increasing costs, rented 40 acres of peat south of Clear Lake. This land was planted mainly to potatoes and flax, but one acre was planted to onions and proved so successful that by the mid 1920's, Sam had shifted his main operation to peat land.

Another factor in the success of the Kennedy operation was Sam's understanding of the need to spray potatoes. In the 1920's, many Iowa potato growers went out of business because they failed to control the potato leaf hopper. Sam started spraying early in the 1900's with a hand pump fixed to a 50 gallon barrel on wheels and drawn by a horse. Copper sulfate did a fair job of controlling the leaf hoppers and lead arsenate and Paris green were moderately successful. The important thing was to spray early, spray late and spray all the time.

By 1930, the reputation of the S-K brand was well established. Sam was honored at home with the award, "Master Farmer", and he was recognized nationally by being asked to testify in Washington before the Agricultural Appropriations Committee. This was the first of many trips, always at his own expense, but Sam knew the only way to solve many of the problems facing the vegetable grower was to get more mony for research and breeding. Altogether, he and his sons have made twelve such trips and the best way to judge the success of their efforts is that before they went, the money wasn't, and when they came back, it was.

Both of Sam's sons returned after the second World War to work on the farm. Jim had his degree in Mechanical Engineering, and Jack won his in Agricultural Engineering. With their help, much of the work was mechanized and the acreage expanded. In 1948 the entire harvesting and storage handling of onions and potatoes was changed to the pallet system. Previously, onions had been bagged by hand in the field and the bags placed on shelves in storage. The new system eliminated all this work and kept handling of the product to a minimum thereby reducing losses from bruises, wounds and rots.

In 1949, Sam and the two boys formed a partnership under the name Sam Kennedy and Sons. In 1952 the firm grossed over a half million dollars in sales and today the Kennedys have 1000 acres in vegetables. This is the result of sixty years hard work starting with 10 acres and one horse.

Sam is most proud however of something other than his attractive home, the vast acreage, the modern storage and the sheds of machinery. He is most proud of the four stars after the firm's name in the Packer Red Book. These four stars mean that he has kept a reputation for honesty, quality and integrity for over fifty years with all kinds of customers. Gentlemen, as a staff member from Iowa State University and one who has had an opportunity to work closely with Sam and his boys for the last fifteen years, it is an honor, a real pleasure and a distinct privilage to present Sam Kennedy's name as a candidate for your Honorary Life Membership recognition.

AUGUST KEHR

GUSTAV H. RIEMAN

It is with much pleasure that I present Dr. Gustav H. Rieman to the Potato Association of America for Honorary Life Membership.

Dr. Rieman was born on a family farm in Faribault, Minnesota. After attending the public schools, he entered the University of Iowa receiving a B.S. degree in 1926. From 1926 to 1931 he was associated with the U.S.D.A. During this period he received a Ph.D. degree from the University of Wisconsin in 1930.

Dr. Rieman served as Director of Research for Associated Seed Growers, New Haven, Connecticut from 1931 to 1936. He supervised and cooperated in the development and production of disease-free seed of superior vegetable varieties.

In 1936 Dr. Rieman began his potato improvement work upon joining the staff of the University of Wisconsin where he is currently Professor of Genetics and Plant Pathology. His primary responsibility has

been in the breeding of new varieties of the potato and in the teaching and guidance of graduate students in Plant Genetics. In addition to the publication of many research papers, he has released or cooperated in the release of four potato varieties, Antigo, Red Beauty, Russet Sebago and a recently named one, Superior. His graduate students have been many, and the majority are working in the plant sciences or closely allied fields.

Dr. Rieman's interest in and contributing to potato improvement have been much broader than his breeding program. Shortly after joining the staff at Wisconsin, he cooperated with others in reorganizing the Wisconsin Certified Seed Program. A key contribution of this reorganization was the development of a system for isolating and maintaining, on a University-operated foundation seed farm, limited quantities of disease-free, high yielding clones of commercial varieties.

He was among the technical workers who have provided leadership in the development of two cooperative research programs, namely: The North Central Regional Project (NC-35), "Potato Improvement Through Parental Line Breeding", and The Inter-Regional Potato Germ Plasm Preservation Project (IR-1).

He has been a tireless and devoted worker in the Potato Association of America. He has served as vice-president and president of the Association. His efforts contributed to the initiation of Sustaining Memberships which have helped very substantially in improving the financial structure of the Association. He was among those who conceived the idea of the Potato Handbook and provided initial leadership in developing it.

Mr. President, as one of is students, it is a privilege and honor for me to present the name of Dr. Gustav H. Rieman to the Potato Association of America for Honorary Life Membership.

CHARLES E. CUNNINGHAM

PREPARING MANUSCRIPTS FOR AMERICAN POTATO JOURNAL

Papers should be based on original research not previously published and not under consideration for publication elsewhere; if accepted, a paper should not be published elsewhere without the consent of the editor. Review papers of outstanding new concepts or theory or news items of general interest to the potato industry will also be accepted. At least one of the authors of each paper should be a member of the Potato Association of America, excepting invitational papers.

Although there is no strict rule on the length of papers, those not exceeding 24 typewritten pages are preferred. The writing should be accurate, clear, and concise; a paper should be as brief as possible.

Type only one side of the page using double-spacing between lines, proper headings, and style. The paper should have four main parts:

INTRODUCTION

MATERIALS AND METHODS

DISCUSSION AND CONCLUSION

SUMMARY

The introduction should begin with a concise statement of the purpose. A review of literature should follow in most instances.

Describe the materials and methods in sufficient detail so other workers can repeat the exact procedures. Arrange data of results in proper sequence and use only such tables, figures, or charts as are necessary to clarify the text.

The discussion should relate the new findings with previous results and should summarize only the major deductions and conclusions.

The summary or abstract should summarize the main findings and conclusions and should not merely say what is in the paper or what was done, it should convey the contents when read independently.

Make two carbon copies corresponding in all details. Submit the original and one copy to the editor. Furnish two sets of illustrations (one may be a facsimile). Keep one copy of the manuscript and one of the illustrations for checking the galley. Arrange copy in this order:

1) title, by-line, running head, name and address for mailing
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8) legends for figures (separate from figures)
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Check the list of references against original sources for:

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Identify each page with authors' names and number all pages consecutively in the upper right hand corner. Never use a number and letter (e.g. 3A) for paging; such pages may be lost without indication that they are missing.

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Make the title short and specific. Include the nature of the study, the organisms, or other primary factors, the technical approach (X-ray, chromatography, etc.).

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A shortened title of 3 to 5 words identifying the main title should appear at the top of each page, preceded by last names of authors.

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The by-line consists of the author(s) name and the institution(s) where the investigation was made. Type the author's name as he customarily writes it, omitting titles and degrees. Name the department and institutions, and spell out city and state. When co-authors represent different institutions, name the institutions in the order of authorship.

Illustrations and legends

All illustrations should aid in understanding the manuscript and should not repeat material presented in tables or text. Line drawings (graphs) should be made with India ink of white stock or tracing paper. Submit originals or good glossy prints on size desired in publication or up to 50% larger to allow clear reproduction when reduced for printing. Remember numbers, letters, and lines are *all* reduced equally and should be large enough to be legible when reduced for printing. American Potato Journal page face is 4½" by 7⅛". Your illustrations should be of such size that space is not wasted; final size 4½" wide or two illustrations 2¼" wide side by side with proper identification. A full page Fig. should allow space for a legend. Allow ½" for 1 line and ⅛" for each additional line.

Photographs should have high contrast and must be printed on glossy paper. The size should be up to twice the size to be published. Crop all nonessential features. Mark each illustration with pencil on the back or

margin, with figure number, author's name, magnification (where important) and indicate top of figure. Unmounted originals are preferred but prints mounted on white paper or cardboard will be accepted. Where possible, combine 2 or more photos into a single illustration, with one legend explaining the figures. Mail photographs flat and protect with stout cardboard or use special photo mailers.

All illustrations must be referred to in the text and be numbered consecutively. Make a note in the margin indicating approximate location desired for all figures.

Type all legends, double-spaced, on a separate paper and do not attach them to the illustrations.

Tables

Use tables sparingly to organize extensive numerical data. They should be used only when necessary to facilitate comparison and reveal relationships. A table should be self-explanatory without the text. The data should be referred to and discussed in the text but never repeated in the text. Make tables as simple and clear as possible, omitting any unnecessary data. A simple bar or line graph is preferred if adequate for the purpose. Use the following format:

1) table *number* and *title* on one line if possible (underline title with one rule)
2) the *boxhead* identifying entries in the vertical columns
3) the *stub* identifying entries in the horizontal lines
4) the *field* containing the data. use a double cross rule to divide the heading from the body of the table. Use a single rule below the boxhead and at bottom of table. Use vertical lines only where necessary to avoid confusion in reading. See accompanying figure. Capitalize only first letter of first words in boxhead and subtitles.

TABLE 2.—*Title (underline to indicate italics)*

Variety	Boxhead[1]		
	Subhead[2]		
	Max.	Min.	
Stub			Field for data

Footnotes
1
2

Literature citations

Accuracy and uniformity in reporting citations are essential. Use complete information to facilitate ease in locating material in libraries.

Literature citations follow the form recommended in the *Style Manual for Biological Journals* published by the American Institute of Biological Sciences, Washington 6, D. C.

The following are typical examples:

LITERATURE CITED

1. Harrington, W. A. and R. L. Olson. 1958. Effect of processing variables on potato granule production. Am. Potato J. 36:241-242.
2. Hildebrandt, A. C. 1948. Influence of some carbon compounds on growth of plant tissue cultures in vitro (Abs.) Anat. Record 100:674.
3. Schwartz, R. J. 1955. The complete dictionary of abbreviations. T. Y. Cromwell Co., New York. 211 p.
4. Van Dersal, W. R. 1938. Native woody plants of the United States, their erosion-control and wildlife values. U. S. Dept. of Agr. Mics. Publ. 303, 362 p.

Literature citations at the end of the paper should be typed double-spaced. In the text use the number system in citing references as: Smith and Jones (6); (Smith and Jones, 6); or merely (6): Number citations alphabetically according to major author's surname. Do not cite unpublished work unless the paper has been accepted for publication or is available from some library. The family name of the senior author is given first, followed by his initials and the junior authors' names in natural order. Only the initials of male authors' given names appear, but women's given names are spelled out.

Abbreviations

The standard abbreviations listed in the *Style Manual for Biological Journals* should be used throughout the paper.

Review by colleagues

Before you submit a paper, ask at least 3 colleagues to review it critically. At least one of the reviewers should be unfamiliar with the particular subject dealt with.

Galley proofs

The first printed form of a paper's text is the galley proof. This is read by the editor for obvious errors and misprints and corrections are made in the margins. One copy is returned to the author, generally with the original manuscript. The author should read the galley carefully at least twice to check for further errors. Make changes only when absolutely essential to correct errors of fact, etc. Engravers proofs of illustrations should be examined for errors and initialed if found satisfactory. Extensive changes require resetting of type and such changes may be charged to the author. Return galley proof and manuscript *promptly*. The editor may need the article for use in the next issue.

Rejections, revision, rewriting

Papers should relate *primarily* to some aspects of problems affecting white potatoes otherwise they will be *rejected*.

Papers lacking adequate experimental evidence to support the author's conclusions will be rejected.

Revision of the paper may be requested if the purpose of the paper and reason for doing the work are not clear. Revision may also be requested if methods and experimental procedure are not presented in logical order and coherently.

Revision may be necessary if the paper consists of an over balance of extensive detailed reviews of literature, experimental procedures or results or if duplication of material in table, charts and text exist.

When a manuscript is submitted to a reviewer, he is expected to answer the following questions:

1. Is the paper a valuable contribution to the literature on white (Irish) potatoes? Has essentially the same material been published elsewhere?
2. Are the data and conclusions presented clearly and concisely? Do the data support the conclusions drawn?
3. Are there errors of fact, interpretation, or calculation?
4. Should the paper as a whole, or any parts of it, be condensed or expanded? If so, which parts and to what extent?
5. Do the illustrations contribute to an understanding of the paper? Are any of them unnecessary?
6. Is the tabular material complete and in good form?
7. Is material in tables duplicated in illustrations or text? Should any tables be omitted?
8. Have all references been cited in the text? Should additional references be cited?

The author should profit by asking these questions about his own manuscript before he submits it for publication.

Rewriting — Editors make an honest attempt to advise authors on ways to improve papers. The authors should not ignore their recommendations. If the editor's recommendations seem unreasonable and cannot be accepted, the recommended changes should at least suggest to the author a need for some improvement. The Editor-in-chief may be forced to reject a paper if the author does not correct his paper as recommended or justify the original construction or statement. Final responsibility for an article is the author's. The editor's responsibility is to the Association and to maintain high standards for the American Potato Journal.

J. C. Campbell
Editor-in-Chief

The author is indebted to the article "Preparing Manuscripts for Phytopathology" by W. C. Price and to the "Style Manual for Biological Journals" for most of these suggestions.

POTATO GROWING IN AFGHANISTAN[1]

Cecil W. Frutchey[2]

My fascination with and my absorption in the new experiences encountered in this part of the world will not permit me to delve immediately into potato topics without first writing a short introductory foreword or preface on the country and its agriculture in general.

Since a great number of my very best friends are members of the Potato Association of America, I would like first to take the liberty to say — Greetings! Greetings from the land of the Hindu Kush, the timeless, ageless land, where Alexander the Great invaded and conquered, where the Greeks came and left their culture on a scale comparable to what the Romans did for western Europe, where Genghis Khan conquered and slaughtered insatiably, and where civilization appears to have reached its peak a couple of thousand years ago.

The Hindu Kush (meaning—Hindu killer) mountains branch off from the northern Himalayas and run west by south across northern India and West Pakistan and on into Afghanistan. In some respects they make the Rockies look puny. They are no more beautiful, nor do they exhibit any more grandeur, but from sheer magnitude, desolation, barrenness, cruelty and inaccessibility they stand apart. Rising from the desert floor to nearly 23,000 feet the mountains restrict agriculture to the surrounding deserts and plains, and the valleys up to nine or ten thousand feet. Many of the mountain valleys are comparatively lush although the only fertility returned to the land is the human "night soil" and animal manure, and the mineral erosion from the mountains that comes onto the land in the irrigation water. Of the 20,000,000 acres of arable land approximately 50% is irrigated from the streams fed by snow water.

There is as such, no farm machinery or equipment, not even horse-drawn. The land is plowed with a wooden plow and a pair of bullocks. It is "floated" by a man riding a plank dragged crosswise behind the team. They have a flat wooden type of slip-scrapper used both as a slip and a bulldozer for pushing dirt, and that is all. The hand tools consist of a shovel and a small square-bladed type of sickle, used as a trowel at planting time and for cutting at harvest time. Nearly all seeds are sewn broadcast, including garden crops, and most crops are made up of varietal mixtures. There are no railroads and few roads. Most of the farm produce moves to the local markets (bazaars) on camels and donkeys. There are few storage facilities for fruits and vegetables and these are largely farm to market, in season commodities. Until the foreign aid programs came into the country during the decade just past, there were no commercial fertilizers used; there were no spray programs of any kind; fungicides and insecticides were entirely unknown; there were no seed improvement programs, no research, no Extension Service, and no agricultural education of any kind. These are all very minor yet. Yet this primitive agriculture, by survival of the fittest methods, is not without its

[1]Written at request of Editor, received July 19, 1961.
[2]Research Agronomist, The University of Wyoming Team, Research Division, Afghan Program, Kabul, Afghanistan.

successes. There is evidence that many of the world's agricultural varieties originated in this region, and they have some of the best flavored grapes, apricots, and melons I have ever eaten; the walnuts, almonds and pistachio nuts are good, and their fat lamb is so good it doesn't taste like lamb. The yields in general are low, the quality is poor, and the waste, decay and spoilage is often extreme. Afghanistan eats better perhaps than much of the rest of Asia and the middle-east. If you ignore nutritive values and vitamin content the country is generally self-sufficient in food production — seldom having surpluses — often many scarcities.

Potato Production

Potatoes are not one of the largest crops but rank as a major food crop. Wheat occupies about five million acres. Barley and corn are listed together at nearly two million acres. There are more than a million acres of cotton, about half a million acres of rice, 50,000 acres of tobacco, 25,000 acres of potatoes, and 10,000 acres of sugar beets. There is also some sugar cane grown in the hotter climates. Vegetables are grown in every village garden and each home has a few fruit trees. The unit of land measurement is the jirib (jeh-reeb), a little less than a half acre, 1936 square meters, or 44 meters square. The yields of potatoes as near as I can determine run anywhere from a poor 2400 pounds to nearly 20,000 pounds per jirib, on the richest soils. They would probably average something less than 50 cwt per jirib. While there are hundreds if not thousands of jiribs of potatoes grown around Kabul, the largest field I have seen was less than two jiribs. There are two local varieties, one, named Garma, is an early round with russeted skin, the other, named Sarda, is medium to late maturing and has smooth white skin. Garma has yellow flesh and apparently sets heavy, producing many small tubers. Sarda is supposedly white fleshed but is subject to so much light greening at the bazaars that it exhibits considerable greening and yellowing under the skin. I hope this summer to determine for certain whether or not there is a degree of yellow color in the flesh. Both of these varieties are excellent cooking potatoes. There is almost no internal discoloration other than the yellowing.

Fusarium dry rot may develop in tubers which lie around the bazaars for some time. To date I have not seen any discoloration that resembles that caused by *F. oxysporum*. Ring rot may be present but if so, is not common. There is a bacterial brown spot with which I am not familiar. One can find plenty of mosaic symptoms in the fields, ranging from a mild type of crinkle to very severe rugose. Some of the rugose types produce intense necrotic browning and much defoliation. Spindle tuber is present in appreciable amounts. Why it isn't 100% is puzzling. Scab and rhizoctonia do not appear to be common on the native varieties. The minor viruses such as purple-top, yellow-top, witches broom, calico, haywire and others are uncommon if not very rare.

The most puzzling disease situation to me is the total absence of leafroll symptoms. Let me hasten to add that my experience to date is limited to one year and to perhaps no more than a hundred acres of potatoes observed; so I certainly could not be very positive. However,

it is astounding not to have found leafroll last summer or so far this summer in either of the two native varieties mentioned.

Insects are generally very numreous. It is a region of aphids — innumerable species — ants and ladybird beetles. I have seen grain aphids build up until the heads were black and then the ladybird beetles move in and a week later the aphids are gone, and shortly after so are the ladybirds. We have an entomologist at the mission, and he has collected hundreds of specimens of aphids and sent them to Washington for identification. The returns are just beginning to come back. He feels relatively certain that the green-peach aphid, *Myzus persicae* occurs here. If so, could it be that the leafroll virus is absent, or by the greatest of chance or natural selection, the two native varieties have become highly resistant to leafroll? This isn't likely, but I have sent a few tubers of each to the USDA for testing. The summer time temperatures run rather high here depending upon altitude, and here at Kabul, 6,000 ft., it often reaches 100 F. during the middle of the day, and the soil temperatures apparently become high, too. It is questionable though, whether the temperatures are consistently high enough to eliminate the leafroll virus. The absence of leafroll symptoms have, however, given rise to these interesting bits of speculation.

Needless to say potato planting is accomplished by hand. The accompanying picture, taken early this summer, shows a small field of potatoes just coming up. As apparent, the soil is scooped into a series of dikes, ridges or beds resembling a disconnected lattice-work pattern. This is done with a shovel. The shovel is over-sized and operated by two men. The blade is nearly square, about 15 inches wide and approximately the same length. At the top corners, each side of the handle, are two rings to which ropes are fastened. The ropes are tied to a stick and a man stands in front and pulls, dragging the shovel with its load of earth into the dike.

The man holding the handle pulls the empty shovel back and shoves it into the ground for another load. Working together smoothly and coordinately the two men produce the effect of a small bulldozer. These ridges or mounds are two to three feet wide and 18 to 20 inches high. The potatoes are planted on both sides of the ridge, five or six inches below the top. Small plants can be seen in the picture at the water line. There are many reasons for adopting this method of culture. As the moisture creeps up the ridge, following irrigation, the salts are carried to the top and there deposited above the root zone. Salty soils are a problem in much of Afghanistan. Another reason is that it appears to improve the yield, and I suspect that in these soils of only average or low fertility this piling up of the top-soil into the mound does bring the limited nutrients closer to the roots. This method also makes for ease of irrigation: the water is simply let in at the top of the field and when it reaches the desired level in the ditches it is shut off and soaks into the soil until it disappears. Still another very practical reason for this ridging process is the ease of harvesting which it provides in the fall; requiring less digging and consequently fewer tubers are injured with the shovel.

Arriving here in June 1960 it was too late for me to plant any crops; so my efforts were confined to making wheat-head selections of native varieties, designing greenhouses, potato cellars and the like until fall. When fall came I planted some winter wheat for seed increase and incorporated into this planting several different experiments, namely: fertilizer trials, row planting versus broadcasting, row spacing experiments, rate of planting tests and minor element studies. This past spring I was able to establish two potato fertilizer plots, using the Garma variety in one, and Sarda in the other. Most of this was done by hand. The fertilizer was applied in bands on each side of the row using a Planet Junior garden planter calibrated as accurately as possible for this work. The potatoes were then planted by hand with an old-fashioned jab-type planter which I brought from home. The treatments are, in available amounts of N, P and K: 0-0-0; 40-0-0; 80-0-0; 40-80-0; 80-160-0; 0-160-0; and 80-160-30 pounds per acre. Tremendous differences are showing in the vines at this time, particularly in the higher rates of phosphate. Phosphates appear to be very deficient or unavailable. When one realizes that some of the soils run as high as 20% or more carbonates it is easy to understand how the phosphates could readily be tied up.

I also have potato variety trials underway comparing six varieties. These are: Russet Burbank, Ultimas, Garma, Sarda, one U.S. seedling of unknown origin, and one Pakistan variety. Many of the U.S. varieties do quite well here, but it is a problem getting them here when you want them, and keeping them until you need them again. Next year I hope to expand the variety trials considerably. We are using, generally, Stateside methods of culture in our experimental work, chiefly because one can get work done when necessary, and because the results are more easily measured than from the dikes or beds. We have in the research division some farm tractors, and I have been able to cultivate and ditch out with them. Since the native tractor drivers are, as a rule, inexperienced, we Americans do most of our own field work, other than hand labor. Usually there are thirty or forty natives standing along the ditch banks as

spectators watching these tractor operations. When the potatoes first broke through along with the weeds, I went in with the hillers and ridged them up, burying most of them. There were many expressions of consternation at this, and an occasional, "Hube-Nace" (it is not good) voiced. A few days later when they had all popped through minus most of the weeds some of them told me, "Hube Shudt" (it has become good).

Potatoes are stored over winter by burying them in the ground below frost level. There is no protection from surface water and no ventilation. Consequently there is a great deal of loss from rotting. Other root crops are also stored in this manner. The Ministry of Agriculture requested plans for a potato storage warehouse when I first came. These were easily supplied and the structure is now largely completed and will be ready for use this fall. It is very similar to the above ground storages in the San Luis Valley, and in so far as I know the only vegetable storage building in Afghanistan. The climate varies extremely here with the altitude. At the two thousand foot, or general desert level, potatoes are a winter crop. From the 5,000 to the 9,000 foot levels they are a summer crop. No doubt storage structures similar to our farm storages in the States would prevent considerable loss and make potatoes and root crops available to the diet over a much longer period of the year.

In conclusion let me relate a little experience I had the last of February, getting seed potatoes for the experimental plantings this summer. One of the young men at the Ministry of Agriculture, who has a high school education and one year at American University at Beirut, said he knew a village about six miles out where we could buy both Sarda and Garma. We needed six hundred pounds of each. Four men went with me in a pickup truck, two aides to supervise, do the bargaining and generally to maintain the status quo and the conversation, and two coolies to do the work. We drove to within a half mile of this village, then followed a foot path and donkey trail the rest of the way. This village is, as are all villages, surrounded by a high, mud, rock and brick wall. A brook runs through it. There is a primitive grist mill operated by water power. Within the compound there were numerous smaller walls surrounding individual houses or groups of houses. I was particularly an object of curiosity by the youngsters and idle men reclining against the sunny side of the inner walls, as we wended our way along the path, across the brook and in and out among the animals. There were the usual introductions, then the owner of the potatoes, who turned out to be the brother of one of the aides, led us out among the apple trees in the yard. When he stopped at a certain spot, they swept the three or four inches of snow away, although I could not detect any evidence of a mound of earth or anything indicative of a cache of vegetables. They carried out a wicker-seated couch for me to sit on. Using a pick they broke through five or six inches of frost. At about eight or ten inches they began finding potatoes. These they sifted out of the dirt, putting them in one of the big copper bowls of the native balance scales. In the other bowl was a rock which the man assured me weighed exactly one seer (15 pounds). In good native custom I picked it up and examined it to make sure there had been no bits chipped off, recently, or perhaps

not since its first selection as an honorable weight. Each seer was weighed separately. The burlap bags we had purchased were huge, holding 10 seers and still tied around the top. Thus we had eight sacks when finished. Incidentally before we were through digging and weighing, as the social part of the transaction, I was invited into the house — where the women made themselves scarce — to drink tea, eat potato chips (home-made of course), and kohl-chah (pastry), all very delicious.

The niceties over we completed the deal. Potatoes were scarce and high priced last winter. I paid less than the bazaar price but even so it was 24 afghanis (one afghani = 2½¢) per seer, or about 4¢ a pound, a good price even in the States, and rather inconsistent with the per capita annual income of but $65. They had three donkeys only, loading two sacks on each one. I presumed they would return with one donkey for the other two sacks. But no — the two coolies, one weighed but 135 pounds, each put a sack on his back. Going ahead of us, with me slipping and sliding along on the muddy trail and crossing the brook a couple of times, they trudged that half mile, each with his 150 pound load, without once falling or stopping to rest. When we got back to the office I carried one of the sacks about ten feet from the truck to the scales, and it was all I could do to move it that distance. One gets an insight into the terrific human endurance capabilities in this land, as well as a view of the horrible illnesses, injuries, and deformities that afflict many of them.

REPORT OF THE LATE BLIGHT INVESTIGATIONS COMMITTEE

During the past year work proceeded on the comparison of the complementary differentials R_6 (Canada), R_6 (Germany), R_6 (Canada) and R_x (U.S.A.)

Dr. W. Black and Dr. Jean F. Malcolmson, Scottish Plant Breeding Station, Pentlandfield, Scotland, tested some 104 isolates of *P. infestans* collected from Italy, Brazil, S. Rhodesia, Holland and Germany and found that certain cultures originally designated races 0. 4 and 3,4 attacked R_6 (Canada) but not R_6 (Germany). Other cultures attacked R_6 (Germany) but not R_6 (Canada). They have concluded that R_5 (Canada), R_6 (Canada) and R_6 (Germany) are different from each other but that the fungus took longer to sporulate in the case of susceptible reactions on the two Canadian differentials. They reported that some isolates gave identical results in every test while others gave variable results with both the new and the old differentials and suggested that the instability of the fungus itself had been the main complication.

Dr. M. E. Gallegly, West Virginia University, Morgantown, W. Va., reported a similar complicating loss of virulence by the Canadian races 1.2.3.4.5, 1.2.3.4.6 and 1.2.3.4.5.6.

In tests conducted at Fredericton Gallegly's R_x strains were tested with the advanced races by inoculating both whole plants and detached leaves. After 5 days in the moist chamber detached leaves generally showed a more extensive development of lesions than whole plants. The Canadian race 1.2.3.4. did not attack any of the R_x material with the exception of WV 41-19 on which a mixed reaction was evident. A few lesions which bore sporangia yielded race 1.2.3.4.6 after sub-culture and re-test on the Canadian R_6 thereby indicating the presence of a mixture of races 1.2.3.4 and 1.2.3.4.6. Reactions of Gallegly's R_x material to the other advanced races varied widely from test to test.

Gallegly at Morgantown and Hodgson at Fredericton have both made progress in the development of techniques for the detection of field resistance under controlled conditions. Gallegly, using a large number of plants per clone, handled in a replicated and randomized manner and inoculated with a race capable of overcoming any resistance due to any R-genes present, rates each plant after a certain time with a disease index covering progress of the disease. Hodgsosn uses replicatd and randomizd discs cut from leaves and inoculated individually with aliquots of a known concentration of zoospores of a race also capable of overcoming R-gene resistance. Both investigators report significant differences in the average disease indices of the various clones sampled.

Dr. J. S. Niederhauser kindly consented to record his impressions of research in progress at the potato breeding centers he recently visited in Europe. This paper may appear in the American Potato Journal early in 1962.

M. E. Gallegly
W. A. Hodgson
W. R. Mills
J. S. Niederhauser
J. R. Wallin
C. J. Eide
K. M. Graham, *Chairman*

REPORT OF STANDARDS COMMITTEE

The Standards Committee would like to submit the following suggestions for consideration by the membership and for possible adoption.

1. Most members of this organization are fully aware of the extreme importance of knowing the specific gravity, dry matter or total solids content of a potato or a lot of potatoes. The evaluation of this characteristic in a potato is of importance to everyone from the plant breeder, grower, handler and processor to the ultimate consumer of the product be it in fresh or processed form.

Most of us also are aware of the several methods which are employed to measure this quality in potatoes. With rare exceptions and usually only in the laboratory, this measurement is made by one of the accepted methods of specific gravity determination. We need not here go into the merits of this form of measurement over that of determining dry matter or total solids, but there are several excellent reasons therefor.

Since most measurements are made by specific gravity determinations, they should be presented as such. In recent years a few individuals, but their members are increasing, have become rather insistent that the specific gravity measurement be presented not as specific gravity but as dry matter or total solids. This, they claim, means so much more to the housewife and other consumers.

This committee presents two very good reasons for resisting this change. In the first place few people understand what "total solids" means any better than they realize the significance of the term "specific gravity". Omitting the use of the term "specific gravity in favor of that of "total solids" would in no way clarify what quality is to be expected from a given lot of potatoes. In addition, most processors are now thoroughly accustomed to thinking in terms of "specific gravity" and any change in nomenclature would be confusing to the group that makes most use of this measurement.

Secondly, and still more important, when data are obtained in the form of specific gravity they should be presented in that form; when obtained as dry matter they should be submitted as such. Any transfer of data from one form to another is likely to introduce an error. There are several unavoidable errors without willfully introducing an additional one. For instance, a specific gravity determination of a lot of potatoes shows them to be 1.075 and it is insisted that you present this to the public as total solids. How is this to be done?

Refer to a table of specific gravity and total solids and then determine which figure you are going to take to represent total solids. There is a choice of figures from reliable sources which have originated in the United States and several European countries. They range from 18.6 to 20.7% total solids. Just which one are you going to choose for your purposes? Which one is correct? You will find just as great or greater discrepancies between specific gravity and total solids content for any of the other specific gravities. Due to different methods employed by the workers in determining specific gravity and total solids content and due to differences in the chemical composition of different varieties used, methods of production, etc., potatoes having the same specific gravity do not always have the same dry weight or total solids content. The answer

therefor, is evident, that the safest and most accurate procedure is to use the specific gravity figure because that is what was measured. When the determination is made of total solids by the dry weight method the data should be presented as total solids or dry matter.

The Committee has no objection to the presentation of specific gravity data converted to dry matter or total solids where this is necessary or desirable. They do suggest very strongly, however, that if this is done the investigator should designate which interpretation has been used.

2 This committee suggests the adoption of the National Potato Chip Institute "Proposed Color Reference Standard", Form 1206-U, January 25, 1954, sometimes referred to as the Coughlin chart for chip color evaluation, with or without supplemental instrument readings such as those of the Hunter Color Difference Meter. Those familiar with this chart are fully aware of its shortcomings and inadequacies, however, the Committee believes that it is the best known and most widely used at present. Until a better chart is developed the Committee believes that we should standardize on the use of this one

Where instrumental techniques are used for the determination of chip color the Committee suggests that the research workers convert thier data also to the N.P.C.I. Color Chart standards for interpretation by persons who do not have these instruments available.

Where possible, these techniques also should be extended to measurement of other fried products, particularly French fries.

3. The Committee recommends that presentation of all future data with reference to potato weights be given in hundred weights rather than in bushels, tons, or other units.

4. The Committee suggests that standards be established for methods of determining specific gravity of potatoes in which such aspects as the following be considered and specified:

i) effect of certain inaccuracies in obtaining weight of sample,
ii) methods of obtaining or selecting samples,
iii) number of samples necessary to represent a certain lot of potatoes
iv) variations between samples selected in certain ways
v) effect of size of tubers selected
vi) effect of temperature of potatoes
vii) effect of temperature of water in which potatoes are suspended
viii) relation betwen potato and water temperatures
ix) other factors which may affect specific gravity determinations.

D. R. Isleib
Hugh Murphy
Ora Smith, *Chairman*

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